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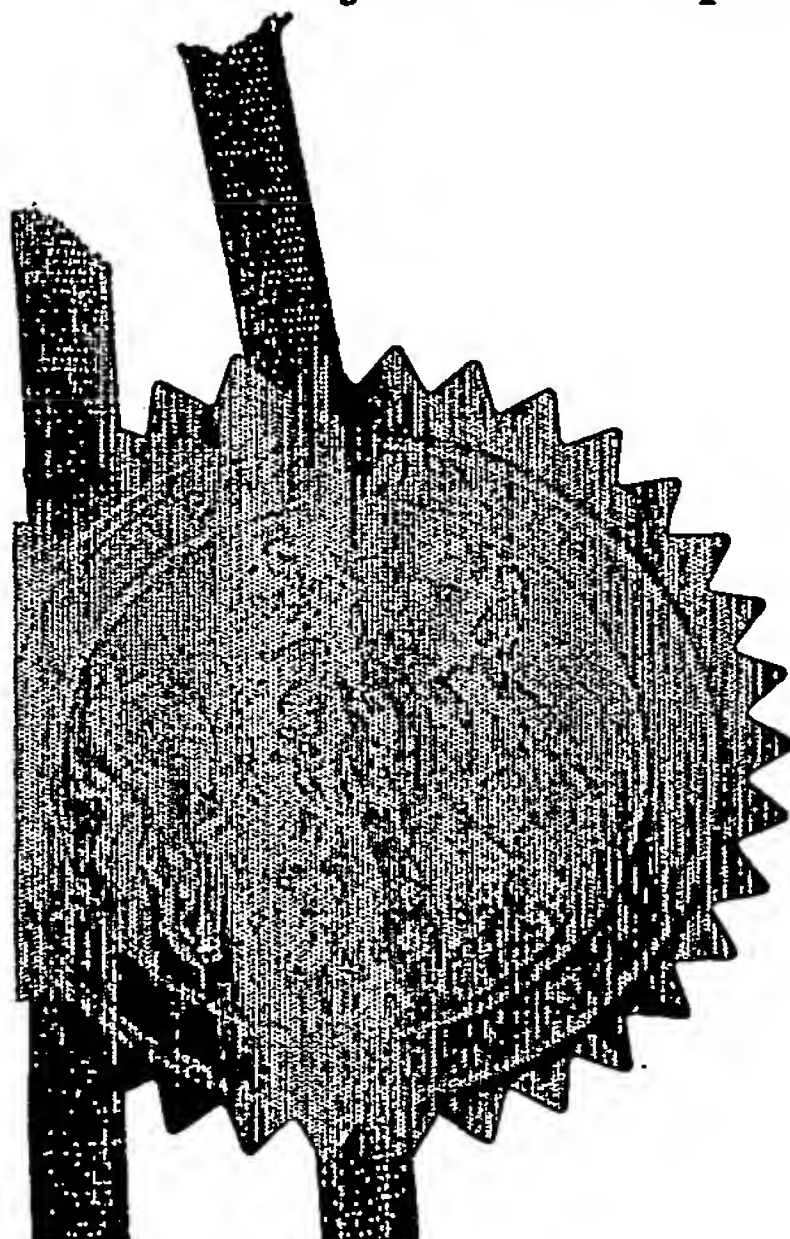
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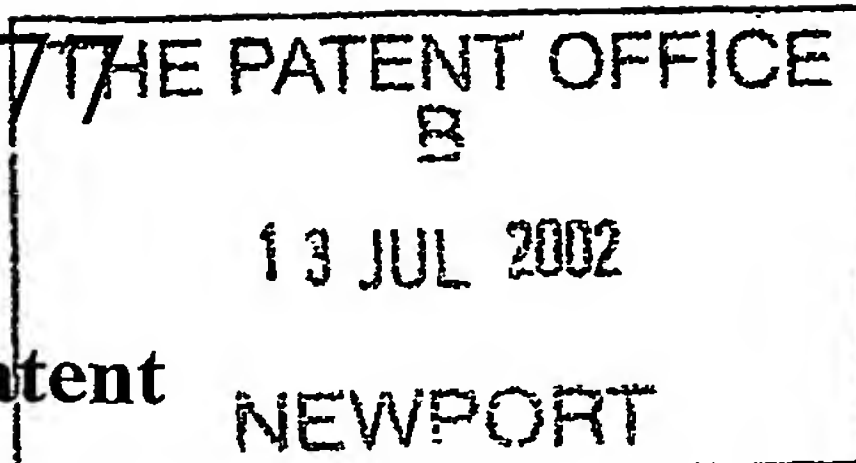
Dated

10 March 2003



Patents Form 1/77

The Patent Office
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Request for grant of a patent

1. Your Reference BA/SLH/V640

2. Application number

13 JUL 2002

0216303.8

3. Full name, address and postcode
of the or each Applicant

Keating Gravure Systems UK Limited
Unit 4

Country/state of incorporation
(if applicable)

Bromfield Industrial Estate
Mold
Flintshire
CH7 1HE

Incorporated in: England & Wales

08276867001

4. Title of the invention

IMPROVEMENTS IN AND RELATING TO
GRAVURE PRINTING

5. Name of agent

APPLEYARD LEES

Address for service in the UK to
which all correspondence should
be sent

15 CLARE ROAD
HALIFAX
HX1 2HY

Patents ADP number

190001 ✓

6. Priority claimed to:

Country

Application number

Date of filing

7. Divisional status claimed from:

Number of parent application

Date of filing

8. Is a statement of inventorship and
of right to grant a patent required in
support of this application?

YES

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form

Description 16 (x2)

Claim(s)

Abstract

Drawing(s) 3 (x2)

10. If you are also filing any of the following, state how many against each item

Priority documents

Translation of priority documents

Statement of inventorship and right to grant a patent (PF 7/77)

Request for a preliminary examination and search (PF 9/77)

Request for substantive examination (PF 10/77)

Any other documents (please specify)

11. We request the grant of a patent on the basis of this application.
Signature Date

APPLEYARD LEES

12 July 2002

Appleyard Lees

12. Contact

Ben Appleton – 0161 835 9655

Improvements In And Relating To Gravure Printing

Field of the Invention

5 This invention relates to methods of manufacturing gravure printing cylinders and to gravure printing styli.

Background to the Invention

~~10 Gravure printing is an intaglio process for long run high~~
quality printing applications. The gravure printing process is a process whereby ink is transferred from small wells or cells that are engraved into the surface of a printing cylinder onto a suitable medium such as paper.

15 The cylinder is engraved by one of three common processes:

- (1) Chemical etching of the image;
- (2) Laser engraving of the cells onto the surface of the cylinder; and
- 20 (3) Electro-mechanically engraving individual cells into the surface of the cylinder.

Once the cylinder has been engraved by either process, the cylinder is rotated through a fountain of ink, and excess
25 ink removed by a doctor blade and returned to the ink fountain. An impression cylinder is used which is covered with a rubber composition that presses the printing paper, or other suitable material, into contact with the ink in the cells of the printing surface.

30

Gravure printing is capable of printing varying amounts and densities of ink to produce images that simulate continuous tone images. The cells that compose the images

on the printing cylinder vary in volume corresponding to the tonal values in the images.

In the case of laser gravure etching, it is capable of displaying etching speeds of up to 70,000 cells per second. However, laser etching involves the use of expensive laser equipment, which can be prohibitive in etching processes requiring only medium to high quality images, or in long run etching processes. Furthermore,

~~10 many conventional printers have existing electro-~~
mechanical engraving equipment, which would be costly to replace and upgrade to laser etching apparatus and processes.

15 Consequently, many gravure cylinders are made by electro-mechanical engraving systems which consist of three main parts. Firstly the system comprises an input unit which is generally a rotating drum on which a photographic printer is mounted in position and scanned by one or more
20 reading heads. Secondly a computer processes the image densities recorded by the reading heads and converts them to electrical impulses that are transmitted to the third part of the system, an output unit consisting of a rotating copper plated cylinder on which are mounted one
25 or more engraving heads with diamond styli that engrave the gravure cells in the copper cylinder corresponding to the strength of the electrical impulses from the computer.

Generally, the diamond stylus used in an electro-
30 mechanical gravuring engraving process is a diamond of triangular cross section, that engraves an inverted pyramid into the copper cylinder. This method produces a diamond or square shaped cell. A conventional gravure

cell pattern is shown in figure 1. Each line of cells comprises a plurality of adjacent cells (10) separated by a narrow channel (12), with each cell (10) in a column being positioned corner to corner with adjacent cells (10). Horizontal lines across the copper cylinder comprise offset cells which produces zig zag channels between adjacent columns and rows of cells on the cylinder as shown in Figure 1.

~~10 As can be seen from Figure 1, a disadvantage in using a~~
diamond stylus of triangular cross section is the formation of a jagged zig-zag edge at the outermost column and row of cells (10) of an image. These jagged edges detract from the overall image quality, and cause images
15 to have a grainy or jagged appearance.

It is desirable in any printing process to attempt to recreate the original image as perfectly as possible, including, in the case of recreating photographic or line
20 drawing images, the continuous smooth edges of each image within the photograph or drawing. The use of diamond styli of triangular cross section in traditional gravure processes prevents smooth edged peripheral lines in the etched gravure cylinder, and hence a subsequent print
25 image from the cylinder will also correspondingly have non smooth peripheral lines.

It is therefore an aim of the preferred embodiment of the present invention to overcome or mitigate at least one of
30 the problems of the prior art, whether expressly disclosed here above or not.

Summary of the Invention

According to a first aspect of the present invention there is provided a method of engraving a plurality of gravure
5 cells in a surface using, the method comprising the steps of:

- (a) mounting an engraving stylus comprising a stylus body inwardly tapering to the stylus tip, in an engraving head;
- ~~10 (b) effecting penetration of the engraving stylus into~~
the surface to a desired depth to produce a cell;
- (c) effecting partial withdrawal of the engraving stylus from the cell;
- (d) effecting relative movement between the stylus and
15 the surface such that the partially withdrawn stylus effects engraving of a channel of shallower depth than the cell in the surface and having a channel width of at least 40% of the width of the previous cell engraved in the method; and
- 20 (e) effecting further penetration of the engraving stylus into the surface to a desired depth, and effecting relative movement between the stylus and surface to produce a cell.

25 Preferably the method further comprises repeating steps (c) to (e) at least one more time, preferably a plurality of times.

Suitably step (c) comprises withdrawing the stylus from
30 the cell such that the channel formed during step (d) has a width of substantially 45 - 65% of that of the previously engraved cell, preferably substantially 50%.

Thus when adjacent cells are the same depth and width are formed, having channels of substantially 45 - 65% width of the cells between each cell, the resultant line of cells have a substantially less jagged periphery than in conventional gravure printing where the channels are generally 15 - 20% of the width of adjacent cells.

The depth of penetration of the stylus during step (e) may be different to the depth of penetration in step (b).

~~10 Thus, adjacent cells may have differing depth and width.~~

Suitably, penetration of the stylus is effected to produce cells have a width of between substantially 50 μ m to 80 μ m.

15 Suitably penetration of the stylus is effected to produce cells having a depth of between substantially 20 μ m to 35 μ m.

Suitably the spacing formed by the channel between adjacent cells is between substantially 14 μ m to 16 μ m long.

According to a second aspect of the present invention there is provided a method of engraving a gravure cell in a surface the method comprising the steps of:

25

- (a) mounting an engraving stylus in an engraving head;
 - (b) effecting penetration of the engraving stylus into the surface to a desired depth to produce a cell;
 - (c) passing direct current through the engraving head
- 30 to effect continual penetration of the engraving stylus in the surface; and

- (d) effecting relevant movement between the stylus and the surface such that the continued penetration of the stylus effects elongation of the engraved cell.

5

Suitably the stylus comprises a stylus body which tapers inwardly to the stylus tip and the method further comprises the steps of:

~~10 (e) effecting partial withdrawal of the engraving stylus from the cell;~~

(f) effecting relative movement between the stylus and the surface such that the partially withdrawn stylus effects engraving of a channel of shallow depth then the previous cell in the surface; and

15 (g) effecting further penetration of the engraving stylus into the surface to a desired depth, passing direct current through the engraving head and effecting further relative movement between

20 the stylus and surface to produce a cell.

Suitably the method further comprises repeating steps (c) to (g) at least one more time, preferably a plurality of times.

25

Thus this method may be used to produce elongated cells having substantially smooth peripheral edges, so that a line of adjacent cells at the periphery of an image engraved on the surface has a relatively smooth peripheral

30 edge compared to cells produced by conventional gravure printing which uses alternating current, which causes the engraving stylus to penetrate and withdraw from the surface quickly, and therefore forms non-elongated cells.

The depth of penetration of the stylus during step (g) may be different to the depth of penetration in step (b). Thus, adjacent cells may have differing depths and widths.

5

Suitably the penetration of the stylus is effected to produce cells having a width of between substantially 50 μ m to 80 μ m.

10 Suitably penetration of the stylus is effected to produce cells having a depth of between substantially 30 μ m to 100 μ m.

15 Suitably the spacing formed by the channel between adjacent cells is between substantially 14 μ m to 16 μ m long.

Thus the method of the second aspect of the invention relies on direct current engraving, allowing an engraving image to be cut without the engraving head oscillating in
20 and out of the surface between two adjacent engraved cells/pixels. The result of this technique, especially with a quadrilateral-faced, planar-tipped stylus being used, gives an engraving image of increased volume compared to conventional engraving, but with straighter
25 horizontal and vertical edges in the cell rows and columns. The use of direct current allows the engraving apparatus to be run without any alternating current.

The method may further comprise effecting complete
30 withdrawal of the engraving head from the surface after a desired number of cells have been engraved, and subsequently effecting relative movement between the

stylus and the surface, before effecting further penetration of the engraving stylus into the surface to a desired depth to produce a cell, such that there is a portion of the surface which has not been engraved between
5 engraved cells. Thus a column of a desired number of cells may be engraved, followed by a non-engraved portion of the surface, after which the column of cells is continued, to a desired number of cells. There may be a plurality of non-engraved portions in any given column of
~~10 cells. Suitably, a non-engraved portion is effected~~
between every 10 to 14 engraved cells.

The length of the non-engraved portion will vary depending on the screen ruling of the surface and the image to be
15 produced.

According to a third aspect of the present invention there is provided a gravure engraving stylus comprising a stylus holder on which is mounted a stylus body comprising a
20 triangular prismatic or triangular prismoid-shaped tip.

Suitably the tip is a triangular prismoid-shaped tip.

Suitably at least one angled face of the triangular
25 prismoid-shaped tip is trapezoid in shape, and preferably both angled faces are trapezoid in shape.

Preferably one or both of the faces of the triangular prism or triangular prismoid have a width of at least
30 substantially 10 μ m, more preferably at least substantially 12 μ m. Preferably one or both of the faces of the triangular prismatic or triangular prismoid has a width of

not more than 80 μ m, more preferably not more than 70 μ m and most preferably not more than 60 μ m.

Preferably the angle of the inward taper of the angled
5 faces to the apex of the triangular prism or prismoid is between substantially 40° and substantially 90°, more preferably between substantially 50° and 80°. Preferably the angle of the inward taper is an angle selected from the group consisting of substantially 50°, substantially
10 60°, substantially 70° and substantially 90°.

Suitably the stylus is a diamond stylus.

Suitably the stylus holder comprises an elongate member,
15 wherein the stylus body protrudes from one end of the stylus holder at an angle of between substantially 15° and 35° to a longitudinal axis of the elongate member, preferably between substantially 20° and 30°.

20 According to a fourth aspect of the present invention there is provided a gravure engraving stylus comprising a stylus holder on which is mounted a stylus body comprising a planar quadrilateral-faced tip.

25 Suitably the stylus body comprises an inward taper to the planar quadrilateral-faced tip.

Preferably, the face of the planar quadrilateral-faced tip is perpendicular to the longitudinal axis of the stylus
30 body.

The planar quadrilateral-faced tip may be a rectangular-faced tip or a square-faced tip.

Preferably the tip is a square-faced tip.

5

Preferably the face of the square-faced tip has a width of at least substantially $10\mu\text{m}$, more preferably at least substantially $12\mu\text{m}$. Preferably the face of the square-faced tip has a width of not more than $80\mu\text{m}$, more

10 preferably not more than $70\mu\text{m}$ and most preferably not more than $60\mu\text{m}$.

Suitably the stylus body is a rectangular parallelopiped shaped body inwardly tapering towards the planar
15 quadrilateral-faced tip.

Preferably the angle of the inward taper is between substantially 40° and substantially 90° , more preferably between substantially 50° and 80° . Preferably the angle
20 of the inward taper is an angle selected from the group consisting of substantially 50° , substantially 60° , substantially 70° and substantially 90° .

Most preferably the stylus tip comprises a frustum of a
25 quadrilateral pyramid, inwardly tapering towards a square faced tip.

Preferably the stylus is a diamond stylus.

30 Suitably the stylus holder comprises an elongate member, wherein the stylus body protrudes from one end of the stylus holder at an angle of between substantially 15° and

35° to a longitudinal axis of the elongate member, preferably between substantially 20° and 30°.

According to a fifth aspect of the present invention there
5 is provided a gravure engraving head on which is removably mounted a gravure engraving stylus of the first aspect of the invention.

According to a sixth aspect of the present invention there
10 is provided a gravure engraving apparatus comprising an image scanning and processing means, operably connected to an engraving head of the fifth aspect of the invention, and an engraving surface, wherein, in use, scanned and processed information is transmitted from the image
15 scanning and processing means to the engraving head which effects movement of the engraving head to image-wise engrave the engraving surface.

The image scanning and processing means may be separate
20 means and may be operably connected to the engraving head by way of electrical cable, telephone lines, satellite or by use of recordable media such as magnetic disks and tapes or optical media, for example.

25 According to a seventh aspect of the present invention there is provided a method of the first or second aspects of the invention using a stylus of the third or fourth aspects of the invention.

30 Description of the Drawings

For a better understanding of the invention, and show how embodiments of the same may be put into effect, the

invention will now be described by way of embodiment with reference to the following drawings, in which:

Figure 1 is an illustration of a gravure cell pattern,
5 engraved by a prior art gravure engraving process using an inverted triangular pyramid-shaped stylus tip;

Figure 2A illustrates a cross-sectional side view of a gravure engraving stylus of the third aspect of the
10 invention;

Figure 2B shows an end view of the stylus of Figure 2A;

Figure 3 is an illustration of an engraved cell pattern,
15 engraved by the method of the first aspect of the invention using a gravure engraving stylus of the Figure 2A and 2B; and

Figure 4 is an illustration of an engraved cell pattern,
20 engraved by the method of the second aspect of the invention using a gravure printing stylus of Figure 2A and 2B.

Description of a Preferred Embodiment

25

We refer firstly to Figures 2A and 2B, which illustrate a gravure printing stylus 12 of the third aspect of the invention. The stylus 12 comprises a stylus holder 14, which is cylindrical in shape, and in which is mounted a
30 stylus 16 comprising a stylus body 18 which terminates at a triangular prismoid shaped tip 20. The triangular prismoid-shaped tip includes two angled faces 24 and 26,

both of which are trapezoid in shape and which extend angularly to an elongate stylus apex 22.

Figure 3 shows an illustration of a partial image engraved
5 into a copper plated gravure printing cylinder, the
engraved image comprising columns of 100% cells 2 engraved
using a gravure stylus of the first aspect of the
invention comprising a stylus holder which is mounted a
stylus body inwardly tapering to the triangular-prismoid
10 shaped tip shown in Figures 2A and 2B. The stylus used
was a diamond stylus having mounted on a substantially
cylindrical holder. The stylus body was such that it
protruded from one end of the stylus holder at an angle of
approximately 24° to the longitudinal axis of stylus body.

15

The engraving stylus was mounted in a engraving head (not
shown).

Using AC current, the tip of the engraving stylus was
20 penetrated into the copper plated surface to a depth of
30 μ m. This produced a first cell 4. Using AC current,
the tip of the engraving stylus was withdrawn from the
copper plated surface partially, and the copper plated
surface was rotated before the engraving tip was made to
25 penetrate further into the surface to create the second
cell 8 upstream of the first cell 4. As the engraving tip
was only partially withdrawn between engraving of the
first cell 4 and the second cell 8, a channel 6 was
produced between the two cells. The engraving tip was
30 only withdrawn to an extent that the channel 6 has a width
of approximately half that of the width of the engraved
cells. Thus, the pattern of cells is such that the outer
periphery 10 of the column of cells has a pseudo-

continuous edge, as shown in Figure 3, as compared to the jagged edges produced by penetration of a conventional triangular cross-section stylus tip, as shown in the illustration of a conventionally engraved image in Figure 1.

We refer now to Figure 4 which illustrates a partial image engraved on a copper plated engraving cylinder using the engraving stylus described for Figures 2A and 2B above.

~~10 In this embodiment, the engraving stylus is arranged to~~
penetrate the copper plate and using DC current, which effects continuous penetration of the stylus in the copper plate whilst the cylinder is rotated, for a desired time and rotational distance. This has the effect, as shown in Figure 4, of producing an elongate cell having continual linear side edges. In order that the engraved cells have sufficient strength in the cell walls, the engraving stylus must be removed partially from the copper plate at prescribed distances to create a channel between cells.

20 To produce the image shown in Figure 4, the tip of the stylus is partially withdrawn at prescribed intervals from the copper plate for a distance of one cell. The use of a square-faced engraving stylus and DC current to maintain engraving and penetration of the stylus in the copper

25 plate to create elongate cells, creates a substantially true linear edge to the outside periphery of an engraved image. This effect is enhanced by providing for only partial withdrawal of the engraving tip at prescribed intervals to create channels of 50% width compared to the

30 width of engraved cells. Thus, images produced as shown in Figure 4 will have smoother edges compared to prior art engraved images using traditional triangular cross section

engraving styli which produce peripheral edges which are jagged, as shown in Figure 1.

In order to further prevent ink flooding out of the
 5 columns of engraved cells 8, for every 10 to 14 engraved
 cells 8, the stylus was completely withdrawn from the
 surface and the surface rotated to provide a cell-free
 gap, after which penetration of the surface was resumed to
 create further cells, as described above. The cell gap

~~10 produced helps to prevent ink spillage from the cells when~~
 ink is loaded into the cells. The length of the cell gap
 will vary depending on conditions such as cell depth,
 image to be created, cell width, and screen ruling of the
 surface.

15

For the pattern produced in Figure 3, the following
 parameters of the engraving stylus shown in Figures 2A and
 2B, the surface, the engraving screen and the method were
 employed:

20

Engraving screen:

35-160 lines per centimetre

Angle of stylus tip to surface 20°-60°

Stylus taper to stylus tip 50°-70°

25 Stylus bottom 20-100µm flat

Cell width 50-280µm

Vertical cell/pixel spacing variable

The reader's attention is directed to all papers and
 30 documents which are filed concurrently with or previous to
 this specification in connection with this application and
 which are open to public inspection with this

specification, and the contents of all such papers and documents are incorporated herein by reference.

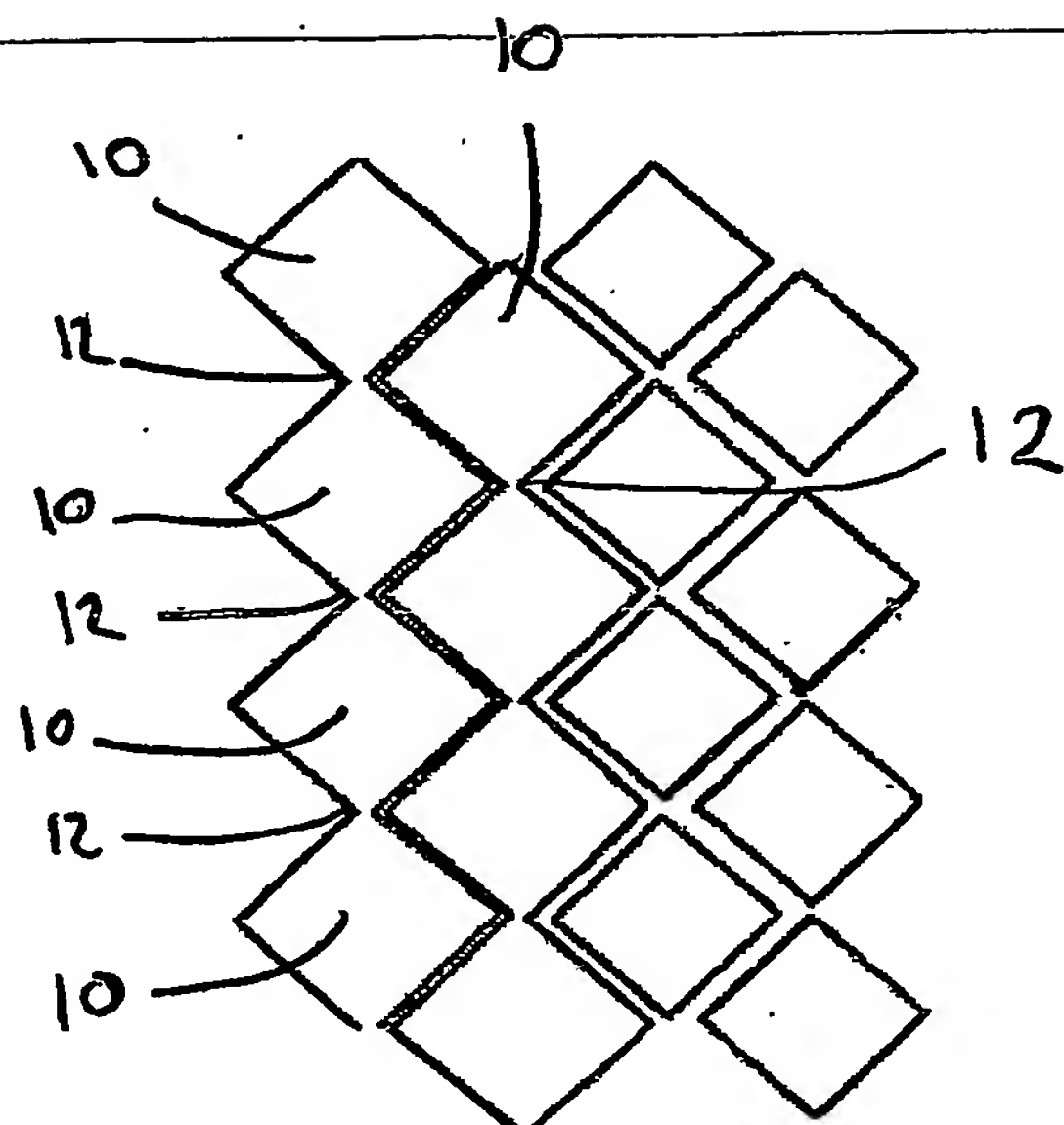
5 All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

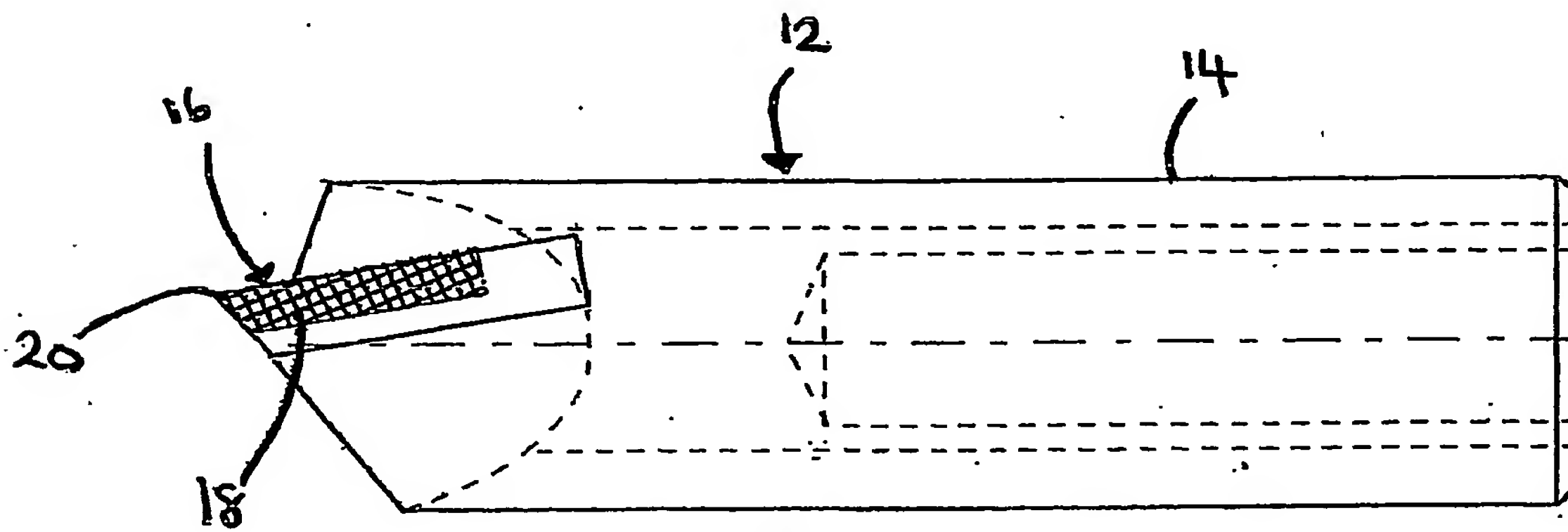
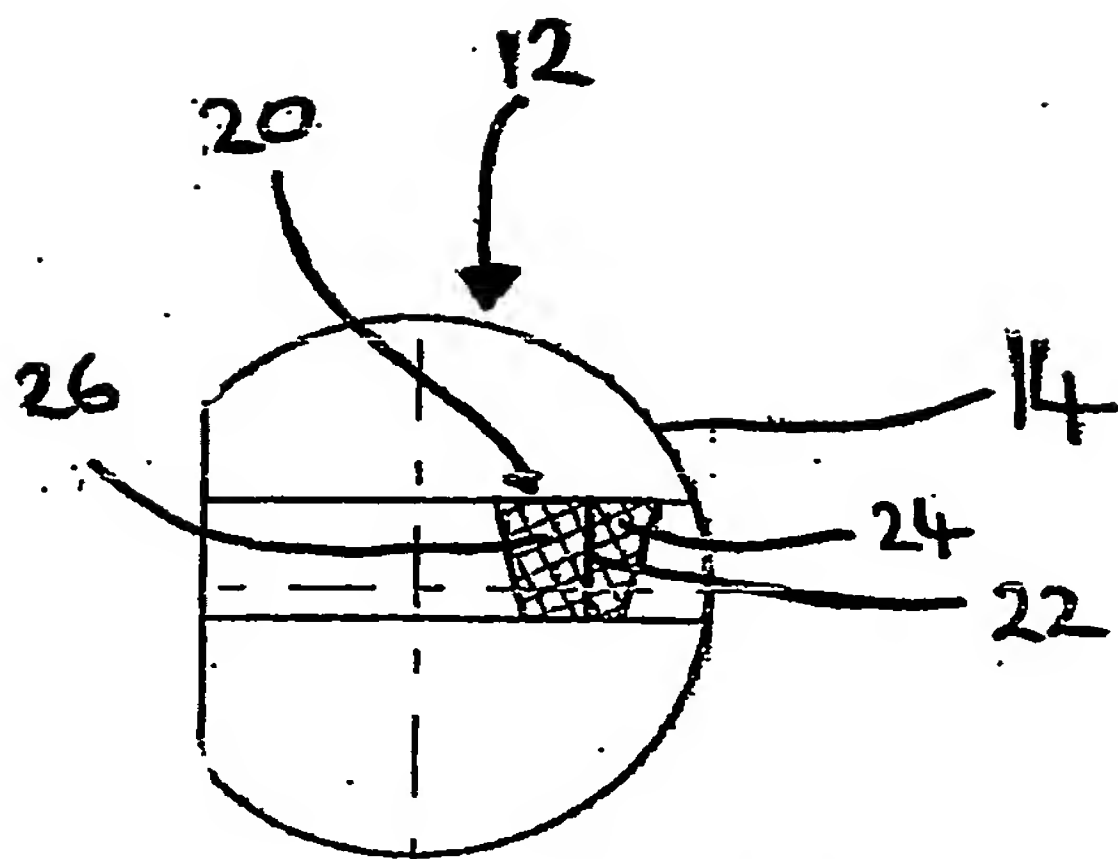
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Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated
15 otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the
20 foregoing embodiment(s). The invention extend to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any
25 method or process so disclosed.

Fig 1





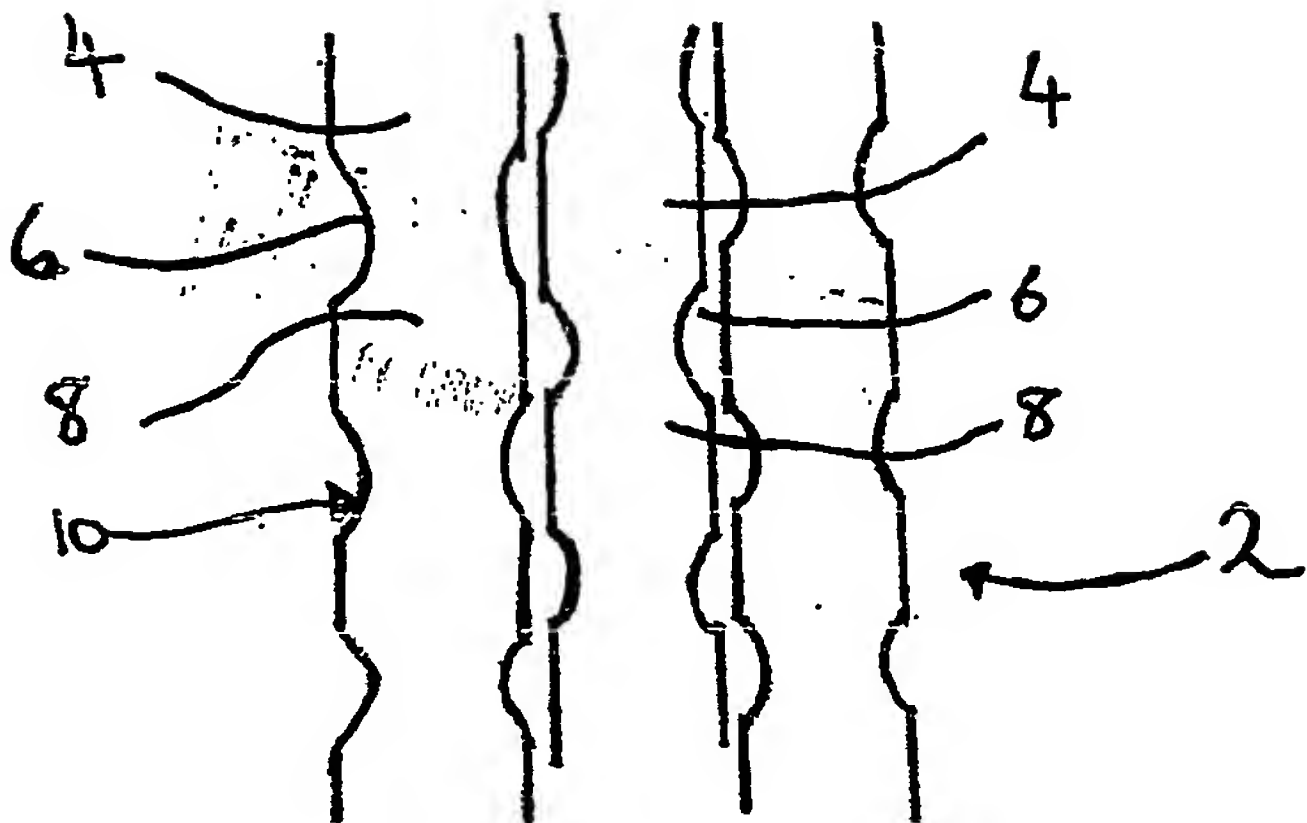


Fig 3

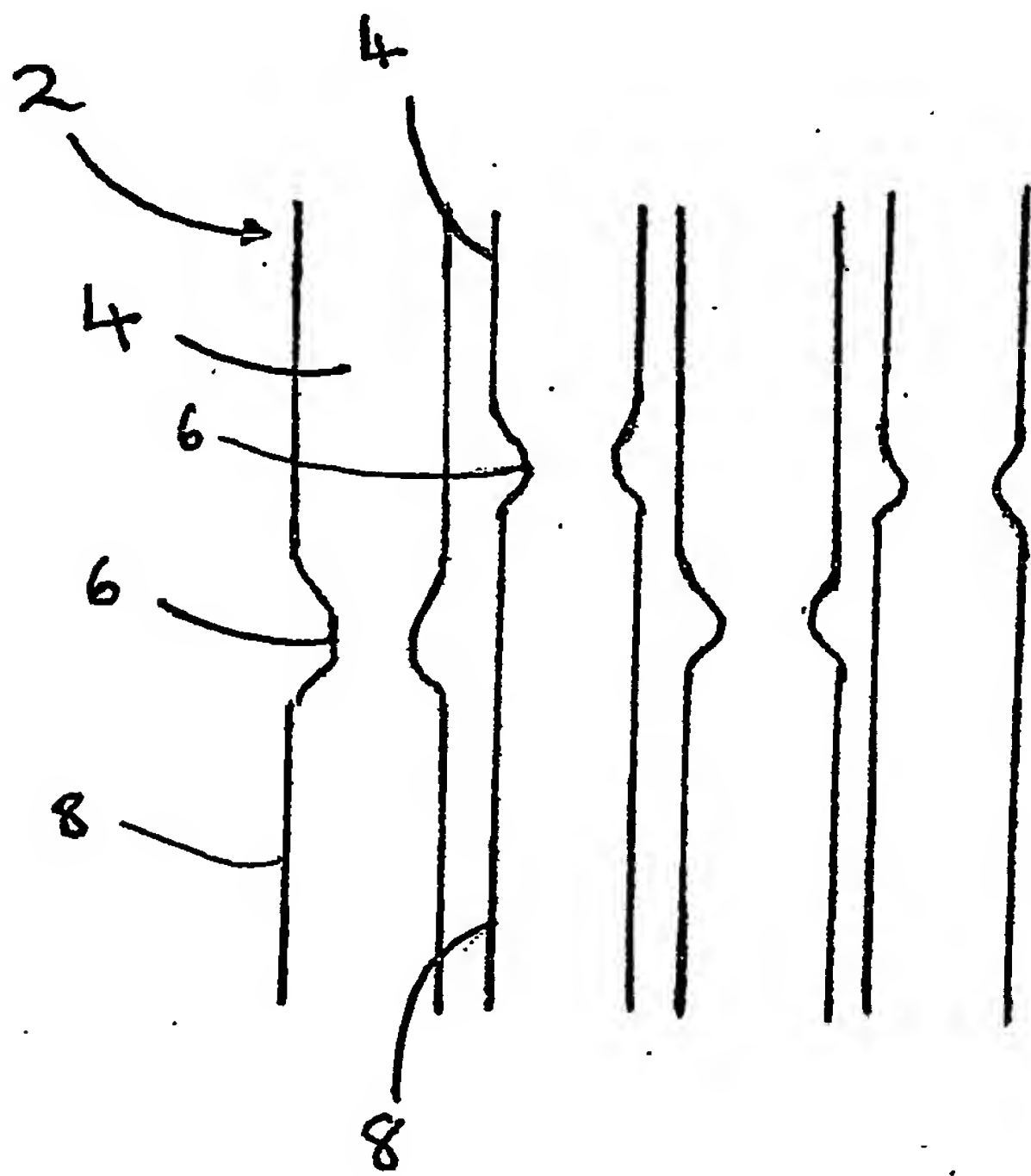


Fig 4

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